Milestone in the elucidation of the phenomenon of long-lived corpus lutea in lynxes

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Lynx cubs. Credit: Iberian Lynx Ex-situ Conservation Programme

The reproduction of lynxes is highly mysterious. Unlike other wild cats, most lynxes are only receptive for a few days once a year. As scientists

from the Leibniz Institute for Zoo and Wildlife Research (Leibniz-IZW) have already shown in the past, this is a consequence of the long life of corpus lutea in the ovaries which prevents further ovulation during the course of the year. The Berlin team has now achieved another breakthrough in solving the puzzle: They were able to isolate several cell types of corpus luteum from domestic cat tissue and characterize their function in detail with the help of cell cultures. The new method can also be applied to endangered felids such as the Iberian lynx and could advance our understanding of the causes and mechanisms of the longevity of corpus lutea in lynxes. The ultimate goal in practical terms is to induce ovulation with the help of corpus luteum hormones. This would enhance the support for the reproduction of the highly endangered Iberian lynx in breeding programs.

When it comes to reproduction, the felids are usually quite unanimous: Most wild cat species go through several sexual cycles per year, so can become pregnant several times a year. However, unlike its relatives, the genus Lynx mainly uses a mono-estric reproduction strategy. Three of four lynx species can become pregnant for a short time only once per year. This is a burden for endangered species such as the Iberian lynx (Lynx pardinus). If they do not succeed in producing offspring within this time, they have to wait until next year. Artificial insemination also failed, probably because of the lack of knowledge about how to induce ovulation. It is therefore indispensable for the success of the lynx conservation breeding program to learn more about the mysterious physiology of their reproduction.

In 2014, the reproduction team of the Leibniz-IZW was able to present the first important partial solution of the puzzle. Together with colleagues from several zoological gardens they discovered that the corpus luteum of lynx is continuously active for several years and thus responsible for their unusual reproduction pattern. The corpus luteum is a glandular tissue in the ovaries of mammals that, among other things,

produces progesterone—the hormone that supports pregnancy and prevents further ovulation. If the egg is not fertilized, the corpus luteum normally degrades quite quickly and thereby enables a new cycle.

"In lynxes, a mechanism has developed that maintains the corpus luteum for several years. This means that the genus Lynx has the longest known lifespan of functionally active corpora lutea among mammals," says Beate Braun, scientist in the Department of Reproduction Biology at the Leibniz-IZW. "It is astonishing that lynxes are ready for reception in a new season despite the presence of corpus lutea. The activity of the corpus luteum is apparently shut down for a short time, which triggers ovulation. Progesterone production is then resumed and held high beyond pregnancy. In this way, the persistent corpus luteum is likely to prevent further ovulations in the same year."

It is still unclear, how exactly the longevity of the corpus luteum is maintained. However, the scientists from Berlin have now come one step closer to solving the mystery. "We succeeded in isolating and cultivating different cell types from the corpus luteum of domestic cats," explains Michał Hryciuk, Ph.D. student in the Department of Reproduction Biology at the Leibniz-IZW. "The cells originate from tissue taken from domestic cats in animal clinics during castration. Tissues from lynxes or other wild cat species are very rarely available—for example when dead animals are found or animals in zoos are castrated for medical reasons. It was therefore important to us to set up a functioning cultivation system first and then apply it to valuable samples, and that is exactly the system that we have now."

The scientists not only succeeded in cultivating several cell types but also characterized large and small cells of corpus lutea under controlled laboratory conditions. They were able to determine the amount of progesterone and other hormones produced and track the changing activity of genes over time. With the developed cultivation technique,

scientific research now has the urgently needed instruments at its disposal to solve the riddle of the long-lived corpus luteum. "Our results will help to identify the hormonal control mechanisms that regulate the growth, maintenance, and degradation of corpus luteum," says Katarina Jewgenow, Head of the Department of Reproduction Biology at the Leibniz-IZW. "This opens up completely new possibilities to enhance the conception of endangered lynxes and other wild cat species in order to support conservation breeding programs."

More information: Michał M. Hryciuk et al, Functional and Morphological Characterization of Small and Large Steroidogenic Luteal Cells From Domestic Cats Before and During Culture, *Frontiers in Endocrinology* (2019). DOI: 10.3389/fendo.2019.00724

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